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A work measurement system, development...

[Washington]

1950

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A WORK MEASUREMENT SYSTEM

Development and Use

(A Case Study)

Management Bulletin

March 1950

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET

Business

WORK MEASUREMENT MATERIALS AVAILABLE

Bureau of the Budget working guides and discussion materials on work measurement are listed below. Single copies will be made available by the Publications Unit, Bureau of the Budget, to those persons in Federal agencies who are responsible for developing or maintaining work-measurement systems. Extra copies can be borrowed if needed for group use.

- A WORK MEASUREMENT SYSTEM: DEVELOPMENT AND USE (*A Case Study*), March 1950—A comprehensive statement of the principles of development, installation, and use . . . for management improvement, program scheduling, and performance budgeting . . . as applied in one large agency, the Office of the Adjutant General. (This publication is for sale by the Superintendent of Documents, U. S. Government Printing Office. The materials below are not.)

- Visual charts (for orientation of executives and supervisors) on the purposes, uses, and main steps in the development of work measurement—8" x 10½" reductions from easel charts. March 1950.

- TECHNIQUES FOR THE DEVELOPMENT OF A WORK MEASUREMENT SYSTEM, March 1950—A hypothetical Case Study covering (1) the analysis of needs for work measurement in relation to program planning, budget administration, and general management, (2) the selection of valid work units, and (3) the development of necessary forms and reporting procedures.

For Management Bulletins on other subjects see inside back cover

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PREFACE

Without measurement the executive works in the dark. He has no basis for comparison or control; no way of knowing his organization's capacity, efficiency, economy, or relative accomplishment. His decisions are guesses.

Mr. Harold B. Maynard, president of the Methods Engineering Council, puts it this way:

> Scientific management is measurement plus control. Before control is possible, measurement must take place.

The idea, however, isn't a new one. Even before Frederick Taylor came along with similar statements, Lord Kelvin had said:

> If you are going to make progress in any sphere of human endeavor, you must first learn to measure the forces that govern the rate of your progress.

You could probably quote many others who have put the same idea in still other terms. But to get right down to the matter at hand, nowhere does the idea apply more pointedly than to the problems of management in Government, as well as in business, today.

As the first chapter of this Bulletin will show, various kinds of measurement are needed for various management purposes—for management improvement in general, for performance budgeting, for program planning, work scheduling, manpower programming, employee motivation, and for accounting and cost control. One kind of measurement that can contribute to all of those purposes, and at all levels of management is *work* measurement. And that is what this Bulletin is about.

Building around an extended case history in the Army's Office of the Adjutant General, and drawing generalizations from many other sources of experience, this Bulletin deals with the problems and techniques of developing and installing a simple statistical system of work measurement—a system that is readily adaptable to a variety of operating situations.

After tracing the development of the system itself, the Bulletin takes up the development of production standards, and then examines the uses to which the supervisor, the executive, and his management staff should put work-measurement data, in the interest of higher output or better service at lower cost.

We wish to thank the people at AGO for their cooperation in making information available and for their work in preparing most of the illustrative charts that are used in the Bulletin.

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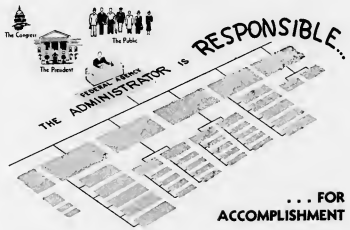
CHAPTER I. THE EXECUTIVE'S INTEREST IN WORK MEASUREMENT



The problems of management grow more baffling as organizations grow more complex in order to meet larger demands and more varied purposes. The problems have grown faster than have the means of measuring the factors involved—the controlling forces and the resources and the impact of organized effort. You can't expect to solve the problems without some means of measurement.

Take the general problem of (1) management improvement; and then take the more specific but still very broad and closely related problems of (2) budgeting on a performance basis, and (3) laying out effective program plans and work schedules.

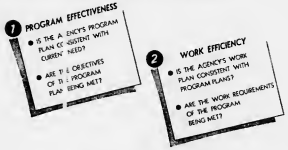
1. *Management improvement*—better or more economical operation—begins and ends with measurement. Without *some kind* of measurement, how can you be sure when changes are needed, or that changes made are really improvements?
2. *A performance budget*—itself a report and a prediction of measured accomplishment in an organization's activities—must be based on *some kind* of measurement applied to the operations within those activities.
3. *Planning programs and making work commitments*, scheduling the use of manpower and facilities, appraising the status of operations—tasks that are common to management improvement and performance budgeting alike—all depend upon *some kind* of measurement applied to the work.

We say "some kind" of measurement because different kinds of work are measurable in varying degrees and in different ways; but, formally or informally, precisely or roughly, some stab at measurement *must* be made if any activity is to be managed. Knowing that, most administrators have cast about at one time or another for an effective, equitable, and yet simple way to measure the work for which they are responsible. How hard the search can be is suggested by the number of seasoned executives who still say, "Show me the system that'll work in my organization, and I'll buy it."

In so saying, however, some administrators have one thing in mind, some another. Some are thinking mostly about ways to measure the progress made toward *program* goals or policy objectives. They are thinking in terms of impact, ground gained, total accomplishment. Others are thinking about *productivity* in its own right—output per unit of manpower applied.

Both kinds of measurement—program and work productivity—are important. An agency may need separate systems for measuring program accomplishment and for measuring work output and efficiency. But, to the extent that work contributes to

THE TWO PRINCIPAL MEASURES OF ACCOMPLISHMENT



program needs, the measure of the work is also one measure of program accomplishment.

It is *work* measurement that we want to talk about in this Bulletin.

The Kinds of Work Measurement

There are two major kinds of work measurement. There is the traditional industrial-engineering kind, which—to oversimplify for the moment—we'll just call the stop-watch method, the garden variety of time study[1] Then there is the simple statistical method, based on the identification of work units and on the reporting of units produced and time applied.

On the stop-watch method there is a well-established body of literature. In fact, so well known is it, so poorly documented is the know-how on other forms of work measurement, and so widespread is the need for *some kind* of measurement, that stop-watch methods are often seized upon and applied to work for which they are ill suited.

Experience in the statistical form of work measurement is not as far advanced as that in stop-watch measurement, and is not represented by as firm a body of literature. Nevertheless, there is enough experience that a set of principles can now be drawn from it.

While a large part of the experience has been quite carefully analyzed, the work of sifting out and correlating all the significant facts and compiling them in an orderly and well-rounded way will take some time yet. Meanwhile, because of the urgent need for work measurement as an aid to performance budgeting, operating appraisal, incentive awards, and management improvement generally, we have recorded one agency's work-measurement experience here in some detail.

[1] We use the term *stop-watch measurement* here to mean any variation of time study, as now customarily practiced in mass-production industries; any method, that is, in which the elements of an operation (the motions or minor combinations of motions) are precisely timed, whether actually with a stop watch or with some other precision-timing device such as a photomicrochronometer. While conventional time and motion study (or more often time study without motion or methods study) is frequently misused, it is also true that—partly because of misuse—it is often shunned even where it could be valuable. Its appropriate use is not limited to mass-production situations. See chapter VI for a brief explanation of this method as compared with the broader statistical approach.

Related Time and Work Reporting

Again a careful distinction may be worthwhile. *Work measurement is a method of establishing an equitable relationship between the volume of work performed and the manpower utilized* in completing that volume. The essential ingredients of work measurement are the measures of output and the measures of employee time.

Reports of work load and records of time and attendance can be, and often are, used separately, with considerable value. In fact, if those separate reports contain the right data they can be brought together to show comprehensive labor (personal service) costs, which in turn can be distributed among various end products in estimating over-all unit costs. But, until and unless the separate output and time reports *are* brought together into a single measure of the relationship between manpower input and product output, they are not measures of work. In ordinary accounting and statistical practice they are brought together (if at all) at a point so remote from the operations represented, and in a form so comprehensive, that much of their value for management improvement and budgeting is missed.

Thus, while ordinary time reporting and separate production or activity reporting may each be statistical in nature, and while each has something to do with work, neither, by itself, is true work measurement. It is in bringing the employee-time factor and the output factor together initially at the operating level, and in terms of that level, that you get work measurement (whether stop-watch or statistical); and thereby you get a measure that is useful not only at the supervisory level but at each succeeding level of management (in the form of either original or consolidated reports).

The Case in Point

The case study presented here illustrates most of the steps to be taken and the problems to be solved in developing, "selling," installing, and using a simple statistical plan of work measurement. It is a plan widely adaptable to operations not suited to stop-watch measurement; and it is a plan especially applicable to group work.

The agency is the Office of the Adjutant General (AGO), Department of the Army. Within the AGO as a whole this work-measurement system is applied to a variety of activities, ranging from repetitive clerical work to professional research. The whole agency is the setting for the development and use of the system. For the problems and techniques of installation, however, the main focus here is upon the St. Louis Records Center, which is engaged chiefly in clerical operations. Hence, the case material itself may not be as useful as we'd like it to be to those who are struggling with problems of measuring highly abstract classes of work. We have taken the liberty, however, of injecting certain generalizations that arise more from other case experience than from that of the Records Center. To that extent this Bulletin is a statement of principles, although the emphasis is on application.

CHAPTER II. GETTING THE RIGHT START

In 1943 the Army had an expanding war on its hands. The Adjutant General's job was cut out for him.

He didn't have to fight the war, but he had to furnish the men who did. He had to help recruit the soldiers, release their orders and assign all the millions of them to initial duty, keep records of nearly everything that happened to them while in service, handle their discharge (or reserve status) when released, and provide information to verify eligibility for veterans' benefits. In addition, he had to keep permanent military records, carry on a personnel research program, operate one of the world's largest printing plants, and provide a host of other vital services to keep the fighting Army fighting.

The AGO Had a Problem

All of those services took manpower. Manpower was scarce. At peak the Office of the Adjutant General (fig. 1) had about 12,000 employees, located in Washington and various field stations. Still the manpower squeeze grew tighter and the work piled higher as the fighting grew heavier and the Army larger. The AGO found it harder and harder to keep on schedule.

How could the agency keep on top of its mounting workload without adding workers who ought to be manning battle stations or work stations in war plants?

Someone Had a Good Idea—the "Bouncing Ball"

Having seen that some employees were busier than others and that some groups were overloaded part of the time and held up by bottlenecks at other times, someone suggested that production standards be adopted, both as a spur to the workers and as a basis for scheduling the work so that bottlenecks would not develop. Thereby, he felt, scarce manpower would be better utilized, personnel requirements more predictable, and budgeting simpler.

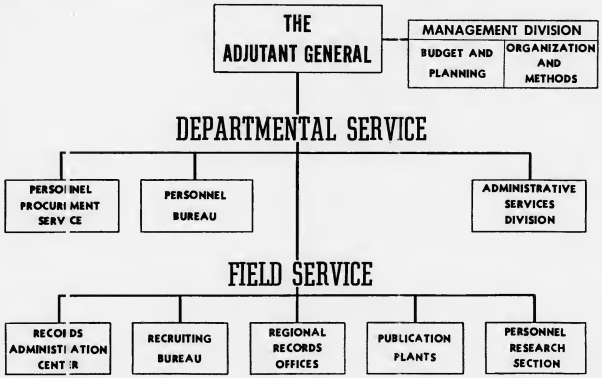


Figure 1

THE "BOUNCING BALL" CHART

WEEKLY OUTPUT

ORGANIZATION RECORDS BRANCH — PROCESSING AND ACCESSIONING SECTION — PROCESSING SUBSECTION OR UNIT

WEEK OF 16 August 1943

	MON	TUE	WED	THUR	FRI	SAT	SUN
UNITS OF WORK ON HAND AT BEGINNING OF DAY	3	3	1	1	2	10	10
UNITS OF WORK SCHEDULED FOR COMPLETION DURING DAY	600	600	600	600	600	500	400
UNITS OF WORK COMPLETED THIS DAY	422	462	506	527	938	802	183
NUMBER OF PERSONS WORKING THIS DAY	6	6	6	6	6	5	4

PAST WEEK'S PERFORMANCE

Figure 2

The idea took hold, and a system known as the "bouncing ball" was born. The agency already kept ordinary reports of work produced; but the reports didn't show how much manpower went into the work turned out. What was needed was a report that would relate man-days to the output of each working group. That was clear. So, on no other basis than supervisory judgment, standards of output per worker per day were set up. A report was devised to show, each day, how each group was doing in relation to its quota.

Here's how it worked. In the "processing" group, for example, the daily standard was 100 units of work per employee. Presumably six people could turn out 600 units. If that schedule was met, the group received a "blue ball" for excellence; if not, a "red ball" for failure. In the same way, the whole week's performance was finally summarized by a blue or red ball. (See fig. 2.) Such was the reward—good or bad—for each group.

The bouncing ball chart was hung in a conspicuous location in each section to spur the employees on to greater production.

The Idea Misfired

It was a good idea. At least, the objectives were worthwhile. But the system didn't work. It was scrapped within 3 months.

The AGO Took Stock

The people in the Management Division (see fig. 1) faced the job of finding out what had gone wrong with the system.

They soon found (as suggested by fig. 3) that opposition had come from the supervisors and division chiefs as well as employees. One division head objected because the system was "too time-consuming;" it took "36½ clerks" to handle the reporting. To that division head the system was not worth the expenditure of so much manpower.

On the other hand, another division head thought the system should be more detailed. He wanted each operation subdivided and reported in terms of

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Figure 3

its component parts. In fact, such a practice had been followed by that division before the time of the bouncing ball; and the supervisors insisted on retaining detailed reporting as an integral part of any new system adopted.

Other division heads had still other objections to the bouncing ball. The head of division D, for example, held that the system did not present a true picture of the time needed to perform a job, since the reports failed to distinguish administrative and supervisory time from actual operating time.

Digging more deeply, however, the management people traced many of the objections back to the way in which the bouncing-ball system had been installed. The main reason given for installing it had been that since production charts were common in industry they should be used also in Government. Because the system consisted of simple charts, it had been assumed to be self-explanatory—something to be casually installed over a week end. In fact, that is exactly what had happened; without prior discussion among the people expected to make the system work, a perfunctory directive dated Friday, June 4, had ordered the system into effect upon the following Monday, June 7 (fig. 4).

While the management people couldn't assign weights to the causes of failure, they could be sure that any one of at least three causes would have been enough to foredoom it:

1. The so-called production standards had been hastily and arbitrarily set and were not true measures of effort;
2. The participation of the operating people had not been utilized in developing the system;
3. The way had not been paved by enough evidence of top-management backing and by line orientation before the plan was installed.

And Then a Fresh Start

The post mortem of the old system was really the first step in developing a new one. If all the people involved had known before what they knew then, the good idea could have worked in the first place as the new one was going to work from then on.

The new system, developed then, was successfully applied to most of the functions of the AGO. Today, nearly 7 years later, the system is still in service.

Of course it wasn't as simple to do it as it is to say it. Responsibility for the staff work of developing and administering the new work-measurement system was placed upon the Budget and Planning Branch of the Management Division, which reported directly to The Adjutant General.

The Adjutant General knew well enough what purposes he wanted work measurement to serve, as far as top management was concerned.

- He wanted a more objective basis for overall control and appraisal.

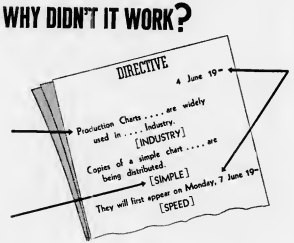


Figure 4

- He wanted a budget based on measured accomplishment.
- He wanted a reliable basis for predicting manpower requirements—not only for budget planning but for actual staffing purposes.

And he thought he had a fair idea of what help work measurement should give to his division heads, branch chiefs, and working supervisors.

Certainly he knew that the system should be simple. For that reason he had the management staff review all of the work reports and time records that were used anywhere in the agency, so that the sound ones could be utilized rather than repeated (and the unsound ones tagged for elimination, consolidation, or simplification) in the development of a new system.

With Line-Staff Partnership

Profiting from past errors, the management staff was sure that the new system—

- *Must* be developed with the help of all levels of the management line and must be designed for their use.
- *Must* receive the continued support of each level of management, stemming from the top.
- *Must* be kept on a current basis to meet changing operating conditions.

So the first step, after the autopsy on the dead system and the review of existing records, was to call all division chiefs together (fig. 5). At the meeting The Adjutant General got their reactions to the old bouncing-ball system, told them what purposes he wanted a new system to serve, let them tell him what needs they faced and how they thought the various purposes could be most effectively and economically served.

Toward Common Goals

It became very clear that the line officials, including the working supervisors, saw as many advantages in work measurement as any of the staff people (the budget officer, organization and methods examiners, personnel officer, and others). It became clear also that, while the line people and the staff people do not always recognize the same advantages, the needs of each often are not as different as the manner in which those needs are expressed. In other

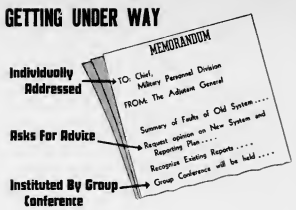


Figure 5

words, each may see the same values in a somewhat different light and express them in different terms.

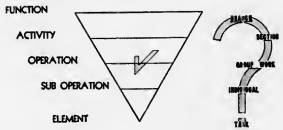
The management staff is interested in the administrator's "control of operations;" the line operator is concerned more specifically with the "control of backlog." Management staff can see the value of work measurement in the system's ability to aid in "planning the work;" the line operator is thinking more specifically of "when, where, and how to get the work out."

Similarly the management staff's consideration of "how to use personnel efficiently" is translated by the line operator in terms of "how many people, what kind, where, and why." Management staff may "evaluate improvements" or new procedures; the line operator wants to know simply "how is the procedure working?" Staff's "comparison of units" might become to the line a problem of "What's wrong with unit 'x' when unit 'y' is doing all right."

Once the various line and staff people got together in their thinking, the path to a workable work-measurement system became fairly clear. They could see that, working together, they would need to (1) select the *level* of work accomplishment at which to measure, (2) select the *work units* in which to measure, (3) select the *time unit* by which to measure; (4) develop a work and time *reporting system,* (5) develop production *standards,* and (6) *use* the resulting data in regular supervision and management.

How the people at AGO carried out those steps and made the effort pay off is what the remaining chapters are all about.

CHAPTER III. SELECTING THE LEVEL FOR MEASUREMENT



As already mentioned, statistical work measurement depends upon the systematic counting of output in relation to time invested. But output of what?

1. What units of accomplishment or performance did the AGO WANT to measure?
2. In what units COULD the agency properly measure?

The two questions represent two aspects of selecting the work units to be counted. Deciding what they *wanted* to measure in the AGO, however, was roughly the same as deciding at what *level* to measure; and first determining the level helped them to narrow down their final search for the work units that they *could* properly count.

To put it another way, *desirable* units of measure are not always *valid* units; but, by elimination, the units that are both desirable and valid may be more readily located if, as a first step, those that are desirable in terms of the purposes for measurement are identified. And that identification can be done by selecting the *level* for measurement.

Measurement Levels

To select the level for measurement is to choose from among the varying degrees of magnitude in work performance as represented by—

1. FUNCTION: all the activities devoted to a single major purpose.
2. ACTIVITY: a grouping of related processes within a single function.
3. PROCESS: a series of closely related operations within an activity.
4. OPERATION: A series of closely related work steps or tasks within a common process.
5. WORK STEP OR TASK: an action taken as part of an operation.
6. ELEMENT: a small grouping of closely related motions within a work step or task.
7. MOTION: a single, simple action (or "basic division of accomplishment") such as "grasp," "hold," "position," or "release."

In the course of determining what they would attempt to measure, the AGO people identified the work of each major organization unit in terms of the above classification (as we will explain in the section of this chapter on "How the AGO Made its Choice"). In deference to established usage in the agency, however, they did not recognize the term "process" as a separate level, but used the terms "operation" and "process" interchangeably.

Why Choose a Level?

For purposes of measurement the levels of performance are significant because they correlate roughly with work products in varying degrees of "completeness," unity, or inclusiveness. In general, for example, the output at the motion, element, and task levels is represented by bits and pieces (or by specific changes made in a piece of work) which may be hard to identify in terms of a significant work product. As a rule, complete work products, or even readily recognizable components, are not found until you get up to the operation level. Then, above the level of the operation and process, the levels usually are represented by several products. At the activity level, you may occasionally find a single significant product; but ordinarily there are two or more, which may or may not be closely enough related to be measurable as one entity. At the function level, there are almost always several products, which, although contributing to the common purpose of the function, are seldom homogeneous enough to measure singly (except for general trend purposes, as explained in ch. IX).

In deciding what they wanted to measure, and hence at which of the possible levels to measure, the AGO people found that they needed to be guided mainly by their *purposes* for measurement.

In their earlier conference, the line and staff people had agreed upon the purposes which they wanted a work-measurement system to serve. They wanted it to contribute to general management improvement by providing the division heads and the central office with an over-all indication of agency productivity, as well as by providing the supervisors and branch chiefs with an objective means by which to judge the effectiveness of the supervision and work methods applied in specific operations or processes. They had all agreed, too, that the system should be of maximum help in budgeting and in work programming and scheduling, including personnel planning.

Since the purposes included the improvement of work methods by the first-line supervisors, would *regular* measurement need to be done in terms of fine divisions of accomplishment, such as motions, elements and work steps? Or would it be possible to save time by moving up to some broader level?

The AGO analysts knew that to make a positive and final identification of valid work units (see the criteria in the next chapter), it is often necessary to start at a level as low as the task or work step, and then (if the *purpose* calls for measurement at a higher level) see to what extent the basic work units can be successively combined without introducing too many extraneous elements. They knew, too, that this bottom-up, rather than top-down, approach has the advantage of encouraging the standardization (or at least the improvement) of methods, procedures, and work flow before premature attempts can be made to standardize production rates (ch. VII). The analysts could see that if such an approach were followed throughout, proper units of output would be identified in direct relationship to purpose and the question of level would answer itself. At the same time, however, they realized that the need to analyze work steps and elements for some special methods-improvement purpose did not make it necessary to apply continuous measurement in those terms. And, in any event, they wanted to take advantage of the product-level relationship as a short cut to appropriate work units, wherever they could reasonably do so.

While they wanted a measure that would clearly reflect inadequacies and changes in work steps and methods, they also wanted to measure in units which could be easily identified in terms of work products, in terms that would require a minimum of recording and reporting effort, as well as a minimum of calculation in using the data for management appraisal, budgeting, scheduling and staffing. To how high a level could they expect to go in the AGO and still find units of work that would be measurable and useful for all the purposes to be met?

How the AGO Made Its Choice

The same question and the same kind of search applied to all divisions and branches of the agency; but to keep the picture clear, let us focus our attention mainly upon one branch of the AGO's St. Louis Records Administration Center, the *Organization Records Branch* (fig. 6).

A look at the kinds of work, the actual work products, and possible work units found at the various levels of performance in that branch may help to clarify the relationship between work level and work unit and show in concrete terms the usefulness of selecting appropriate levels as a cautious and tentative step toward selecting actual units.

The Organization Records Branch maintains all noncurrent records of active and demobilized Army organizations. It answers inquiries from public and private sources concerning the activities of the personnel and of the military organizations represented by those records. As the chart shows, the branch consists of the *Processing and Accessioning Section*, the *Special Services Section*, and the *Correspondence Section*—organizational names that happen to correspond to the three program activities of the branch.

The Function

The branch's function could be regarded as making military organization records available for use (custody of records).

The function included two classes of activity: (1) program activities, and (2) administrative services.

The program activities (as suggested by the section names and as shown in fig. 7) were called: (1) *accessioning and processing*, encompassing all of the regular work operations necessary to receive, classify, and store the records; (2) *special services*,

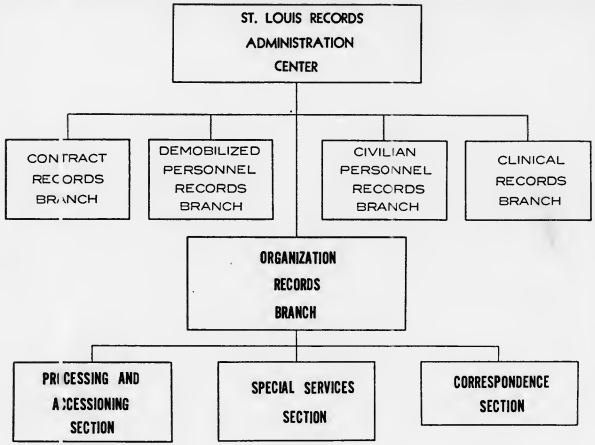


Figure 6

the work of finding and extracting information from the records on request; and (3) *correspondence*, necessary to answer inquiries.

It was obvious that all three activities contributed to the branch function. Each, however, involved work independent of the others. Thus, there were times when the flow of incoming records was heavy and requests for information light. At other times the demand for information was high and the flow of incoming records low. At still other times the load was heavy in both activities at once. Furthermore, the kind of effort, the skills and knowledge required in performing work within the different activities varied significantly.

ANALYSIS OF THE FUNCTION

FUNCTION	ACTIVITIES
CUSTODY OF MILITARY ORGANIZATION RECORDS	ADMINISTRATIVE
	ACCESSIONING AND PROCESSING
	SPECIAL SERVICES
	CORRESPONDENCE

Figure 7

Because the methods, procedures, the skill and effort input, and the work load in the different activities of the function varied significantly, and because the variations were in no constant relationship to each other, measurement in terms of any single unit broad enough to cover all the work of the function would not have been suitable for gaging the efficiency of individual methods or of specific groups of workers, and would not have been useful in gaging staffing requirements for actual personnel planning. An over-all trend of work load and backlog could have been developed in terms of the function, and the trend figures could have been of some use in making very general periodic appraisals and in justifying budget estimates; but even for those purposes the validity and usefulness of measurement on a function basis alone would have been quite limited. The measurement would not have reflected actual work effort.

The Activities

The activities had been identified in making the general analysis of the function. To analyze the activities then required the identification of specific operations, or what elsewhere might have been called processes. (See fig. 8.)

ANALYSIS OF THE ACTIVITIES

ACTIVITIES	OPERATIONS
ADMINISTRATIVE	MAIL AND MESSENGER SUPPLY LABOR FORCE
ACCESSION AND PROCESSING	RECEIPT AND CHECKING PALLETIZING FIRST ECHELON PROCESSING FINAL PROCESSING
SPECIAL SERVICES	ROUTINE SEARCHES SPECIAL SEARCHES
CORRESPONDENCE	NONE

Figure 8

The *accessioning and processing activity*, for example, was examined and found to include such operations as "receipting and checking" (a simple clerical process), "palletizing" (essentially an unskilled manual stacking process), "first-echelon processing" (a rough, clerical sorting and file-preparation process), and "records perfection" (a more refined checking, classifying, and integrating process known also as "final processing"). Not only were there fairly apparent differences in the kind and amount of skill and effort that went into the different operations, but the work loads varied in no constant relationship. At times records were received in such volume that little effort could be devoted to first-echelon processing and none at all to final processing. At other times the incoming volume was light enough that effort could be concentrated on palletizing and first processing. Only after the backlogs in those processes were reduced could the final processing (perfecting) be brought up to date. Thus, for about the same reasons that were found at the function level, measurement for all the purposes to be served apparently would not be desirable in terms of the *accessioning and processing* activity level.

On the other hand, in examining the *correspondence* activity, the analysts found a quite different situation. As far as the main work load of the activity was concerned, they found, as might be expected, that letters prepared were variable not only in length, but in complexity and degree of difficulty. Furthermore, the tasks of letter preparation were performed in varying ways (in terms of sequence and method) by different employees. Nevertheless, the flow and volume of the work were such that, over a relatively short period of time, the differences tended to cancel each other out. A single product, a letter, could be easily identified; and the average number of letters produced within a given time period apparently would be meaningful in appraising the efficiency of the group as well as in budgeting and planning for any foreseeable increase or decrease in work load. So in the *correspondence* activity it appeared that the activity level would be a suitable one at which to measure for all of the regular purposes that had been agreed upon.

In the *special services* activity there were only two major operations: "routine searches" and "special searches." In name, the two operations sounded much alike; and, in fact, both consisted of obtaining from the records information needed by the Correspondence Section in answering inquiries. An analysis at the operation and suboperation levels, however, brought significant differences to light (fig. 9).

Before looking at how the AGO staff went about their analysis of operations within that activity, let us leave the activity level as such by saying that the analysts and line people, together, examined activities throughout the organization in much the same way that they did here. In most instances they found that measurement applied at that level would not serve all of the purposes that they had in mind. Where there was doubt they dug into the lower levels, as was necessary in the *special services* activity, before passing up an activity as a suitable level.

The Operations

For an example of the analysis that the AGO staff applied to operations, let's follow the steps taken in the Special Services Section.

Careful study showed that there were five major sources of inquiries (fig. 9). The first inclination of the branch supervisors had been to recognize five "operations" corresponding to those sources, and to

ANALYZING AN ACTIVITY (SPECIAL SERVICES)

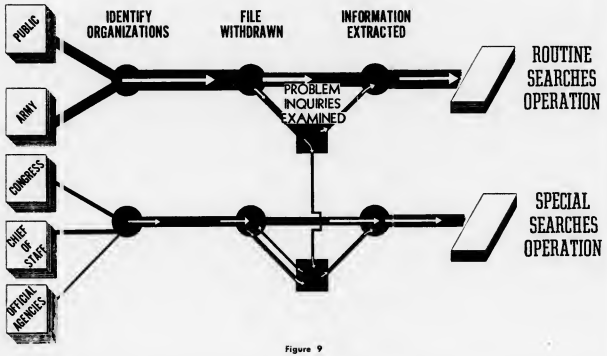


Figure 9

measure accordingly. However, each inquiry, regardless of source, normally went through a similar process, about as follows: The inquiry was examined to identify the organization to which it pertained; next, the organization file was found and pulled; if the information found in the file was adequate, that information was extracted and sent to the Correspondence Section.

Sometimes, however, the file could not be found without prolonged search, or, if found, did not contain all the necessary information. Such problem inquiries were examined by a separate group and, if important, exhaustive search was made.

The problem inquiries from public and Army sources were not returned to the group that had made the original routine search (shown in fig. 9) but were transferred to another group set up to do special searching. This special-search group was responsible also for inquiries from the Congress, the Chief of Staff, and from certain "official agencies."

In other words, although there were five sources of inquiry, all inquiries fell into one of two categories, according to the degree of service required: All normal cases from the Army itself and from the public were handled by *routine* search; and certain abnormal cases from the Army or public, along with all cases from the Congress, the Chief of Staff, and "official agencies" were handled by *special* search. Although the steps in processing the different types of inquiry were the same, the amount and intensity of search (per case) varied as between the two groups. Thus, a case completed by the one group did not represent skill and effort comparable to that of a case completed by the other. Accordingly no single measure could be equitably applied to the activity as a whole; and no single measure seemed likely to be useful in budget estimating or staff planning for the activity as a whole.

The varying classes of work, however, had been combined resourcefully to form two homogeneous operations, each of which, alone, did provide a desirable basis for measurement.

Similarly, throughout the AGO, the analysts found that it was usually at the operation level that people were found to be working together in groups turning out significant and identifiable work products that could be expressed in terms suitable to the purposes for which the measurement was to be done.

The Suboperations

As we have seen, in order to analyze operations the analysts had to examine specific work steps and tasks as performed by individual employees. Analysts and line people alike recognized the need for special studies to be made in terms of tasks, elements and sometimes motions, as a basis for improving methods, procedures, and work flow; but they agreed that such "divisions of accomplishment" were too detailed and dispersed to be a basis for continuous measurement. A great many work tallies would have to be kept by, or for, the individual workers. The recording and reporting burden would be prohibitive. Many of the counts would be too small and specialized to be statistically significant. Any units or terms of measurement applicable to such narrow divisions of effort would require extensive reconciliation, conversion, and summarization before they could be used for general appraisal, cost analysis, budgeting, work scheduling, or personnel planning.

The Level Chosen

Measurement at the *operation level,* however, would give evidence of the need for special analysis at the suboperation and job-element levels. In other words, while the operation level would not always provide full and direct insight into the production inadequacies of individual workers, it would indicate inadequacies in specific groups, thus narrowing down the search for sources of difficulty and signalling the need for more intensive analysis as conditions might warrant.

Since, in addition, the *operation level* usually seemed most useful for budgeting, staffing, and general management-control purposes, that was the level selected, in most instances, for regular work measurement in the AGO.

Let us point out again that what the AGO called the operation level is often known elsewhere as the process level; but, in any event, the level indicated is that at which significant and readily identifiable work products (or resultants) ordinarily appear, and that level may be anywhere between suboperations and activities.

For purposes of simplicity and emphasis, we have saved for separate discussion in the next chapter the actual selection of the work units that are to be counted. But you will see that in fact the choice of level and of unit are products of the same analysis. While preliminary determination of the level leads to the *desirable* work unit and often provides a shortcut to the *valid* work unit (not always the same things), you can never be entirely certain that you have picked the right level until you test the work unit found at that level and prove it to be valid.

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CHAPTER IV. SELECTING THE WORK UNIT

1. Countable
2. Expresses Output
3. Reflects Work Effort
4. Consistency
5. Familiar Terminology

Having selected the level at which measurement was to be done, the AGO people next faced the problem of selecting the right work units. In that process they first had to identify (*a*) that work which would have to be considered unmeasurable in terms of work load, and (*b*) that work which was measurable in terms both of work load and of time. By that means they would further narrow down their search, concentrating on the analysis of measurable operations. The process of analysis at this stage was only a continuation of the analysis begun in selecting the right level.

Pegging the Unmeasurable

Earlier analysis had been enough to show, considering relative volume and purpose, that it would not be feasible to try measuring certain classes of work.

In the category of unmeasurable work fell all activities in which the number of employees was governed not by the volume of work but by more or less arbitrary factors or inalterable conditions, such as—

1. Statutory provisions (the "X" board must have three members);
2. Organization structure (e. g., chiefs of bureaus and their personal staffs);
3. Open-end objectives and unpredictable results (as in certain types of research work); and
4. Fixed installations (such as guard towers, or field offices operated for the convenience of clientele irrespective of work volume).

If such criteria control the manning of positions, the selection of a work unit is unnecessary; and only time reporting for the unmeasurable operations should be required.

As already shown, the "administrative" activity in the Organization Records Branch was not directly related to work volume. The messenger service, for example, operated according to a schedule of pick-ups and deliveries which was established only partly on the basis of branch work load. That work load, of course, indirectly would affect the messenger service; if the work load became heavier, more frequent pick-up and delivery would be necessary, and would probably require hiring additional personnel. The effect, however, would not be direct.

The same was true, also, in the supply operations and the maintenance-labor service. The size of the maintenance-labor force, in fact, might bear an even less direct relationship to branch work load, much of its work depending on the condition of the storage areas, rather than on the number of records handled.

It is true that careful attention to work methods and work scheduling in service and administrative activities can often lead to a degree of standardization that makes measurement both possible and profitable, especially if the volume of such work is heavy and if enough trained methods analysts are available to tackle the developmental job. In fact, it was found desirable to measure the work of the personnel, mail and messenger, and the administrative services in other parts of the AGO. In the Organization Records Branch, however, the total administrative activity represented a very small portion of the time expenditure for the whole function.

The management staff and line officials, therefore, considered the selection of work units unnecessary for the administrative operations, in this instance, and jointly decided to require only the reporting of employee time.

Analyzing the Measurable

Having identified the unmeasurable work, they directed their attention more intensively upon those operations which the earlier stages of analysis had led them to believe might be measurable—namely, the operations into which the *accessioning and processing*, the *special services*, and the *correspondence* activities had been classified.

The Criteria

Since the object of their further analysis was to identify units of work that would be suitable for measurement, they first needed to agree upon criteria by which to recognize a proper unit when they saw it.

Drawing upon the lessons of the bouncing ball, as well as upon the broad analysis they had done in selecting the level, they decided that the following were the criteria of a valid work unit for work-measurement purposes:

1. The work unit must be *countable;* that is, expressed in quantitative terms, such as a case, a letter, a file drawer.
2. The work unit must express *output;* that is, volume of work completed, such as a case processed or a letter prepared.
3. The work unit must reflect *work effort*. The work unit which measures the *results* of work performed does not necessarily measure the effort expended in performing that work. For example, results of processing license applications may be in terms of the number of licenses issued, whereas work effort might be measured in terms of applications processed; for if a large number of applications are rejected there may be a very appreciable difference between the licenses issued and the applications processed.
4. The work unit must have *consistency;* that is, the unit must have the same meaning throughout the organization and from one period to another. It should be possible to compare work-measurement results for one part of an agency at any given time with results for other parts performing the same type of work, as well as to compare the results in a single operation on a time-trend basis. The quality specification of the work performed must be consistent over a period of time. In other words, the *same* work must be measured in the *same* work units by the *same* methods of counting and reporting.
5. The work unit must be expressed in *familiar terminology*—familiar, that is, to those who will be responsible for maintaining the work-load reports. For example, since the branch used the word "palletizing," the analysts used that word to represent what might have been more simply called a "stacking" operations.

WHAT DOES WORK UNIT MEASURE

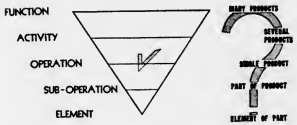

Figure 10

The Work Units Identified

Bearing out the point of relationship between the work level and the work unit mentioned earlier, the AGO people found that, to meet the criteria, a work unit usually had to be some single work product (although it might also be a component of a larger end product). Thinking back to the different levels of work that they had examined, they saw (as suggested by fig. 10) that, in effect, the function was represented by a number of products; that the activity, too, was ordinarily the sum of several products; while the operation (or process) generally represented a single product, usually the end-product of several steps in the production process. The suboperation and element represented segments of the single product.

Applying the tests of countability, expression of output, reflection of effort, consistency, and the over-all test of a single completed work product, the AGO people proceeded to select the work units in the measurable operations. (See fig. 11.)

The *accessioning and processing* activity consisted of four operations, each producing a single finished product.

As the organizational records arrived at the Records Administration Center from field installations, they were examined, checked, and catalogued (the receipting and checking operation). A "file drawer accessioned" was considered a satis-

ANALYSIS OF OPERATIONS AND WORK UNITS

ACTIVITY AND OPERATION	WORK UNIT
1. ADMINISTRATIVE	
MAIL AND MESSENGER	
SUPPLY	
LABOR FORCE	
2. ACCESSIONING AND PROCESSING	
RECEIPT AND CHECKING	A FILE DRAWER ACCESSIONED
PALLETIZING	A LINEAR FOOT PALLETIZED
FIRST ECHELON PROCESSING	A LINEAR FOOT SCREENED
RECORD PERFECTION	A LINEAR FOOT PERFECTED
3. SPECIAL SERVICES	
ROUTINE SEARCHES	A CASE PROCESSED
SPECIAL SEARCHES	A CASE PROCESSED
4. CORRESPONDENCE	A LETTER PREPARED

Figure 11

factory work unit. Each drawer was of standard dimension, so that it could be counted. It remained consistent. It reflected uniform effort. It was, in effect, a single completed work product.

Records that had been received and checked then had to be "palletized." But, because that work did not always follow receipting and checking in direct sequence it was a separate operation, and had to be measured by a separate work unit, a "linear foot palletized."

In order to serve clientele effectively, the records had to be orderly. The work of putting the records in that condition was called "first-echelon processing" and was measured in terms of a "linear foot screened."

To the extent practicable, the records also had to be integrated. This final sorting and preparation of the files was known as the record-perfection operation. Because that work needed to be done separately as other work-load permitted, it too had to be considered a separate operation and measured by a separate unit, a "linear foot perfected."

The *special-services* activity, which consisted of two operations, routine searches and special searches, was analyzed in the same way. A "case processed" was selected as an adequate work unit for each of the operations. Care had to be taken in defining what was meant by the term "processed." An inquiry was considered processed only when some final action had been taken on it.

In the *correspondence* activity, a single work unit, "a letter prepared," was selected, careful analysis having shown that a further break-down into operations was unnecessary. Whether an inquiry required routine search or special search made little difference, the analysts decided, because the time required to prepare the resulting correspondence averaged about the same in either event.

Throughout the AGO, work units were identified in much the same way as those in the Organization Records Branch.

CHAPTER V. SELECTING THE TIME UNIT

- ☐ MAN - YEAR
- ☐ MAN - MONTH
- ☐ MAN DAY
- ☑ **MAN - HOUR**
- ☐ MAN - MINUTE

The staff people assigned to the work-measurement project had no trouble getting the line officials and supervisors to agree that it was just about as important to choose the right unit of *time* as it had been to choose the right unit of *work*. They could all see that records kept in terms of an inappropriate time unit would mean a lot of needless work—not only in the record-keeping itself but in converting the recorded data into summary reports and in reconciling the work-measurement records with the budget, pay roll, and accounting records.

The Criteria

They recognized that an employee is not constantly performing work on a single operation; part of his day may be taken up by periods of rest or of waiting for work to be delivered, by paid or unpaid leave, or by attendance at training and orientation sessions. Part of such time may be directly related to specific operations, but some of it is only indirectly related.

Thus, in customary terms, a working day is ordinarily divided into *productive* and *nonproductive* time. *Productive time:* That time during which an employee is in a "work status;" i. e., the time spent in actually performing work chargeable to an operation, including time worked in excess of the normal working day, together with appropriate rest periods, and necessary stand-by time chargeable to the operation. *Nonproductive time:* All periods out of the work day that an employee spends away from his work station, including time on paid or unpaid leave, or in special training.

The AGO people wanted a time unit that would apply conveniently to all forms of both productive and nonproductive time so that *100 percent* of each employee's working time could be accounted for and properly related to the unit of output.[5]

Considering their purposes for measurement and anticipating the work of record keeping to be involved, they assumed that the time unit selected must be:

1. Easily recorded and reported;
2. Capable of verification (as by official time and attendance records);
3. An accurate reflection of actual time spent in the performance of work;
4. Comparable over a period of time;
5. A suitable means to distinguish among the different types of work on which time on duty is expended.

The Choice

Theoretically, they could have used any unit of time—man-year, man-month, man-week, man-day, man-hour, man-minute, or any other—as long as they picked one and stuck to it.

In the light of their criteria, however, they questioned the accuracy of time data kept in terms as broad as a man-year or a man-month, especially if the time distribution must be made among a number of different types of work. Further, they felt sure that it would be unduly time-consuming to verify time records expressed in fractions of a man-month or a man-year against official time and attendance records expressed in hours for biweekly pay-roll

[5] As a formula for manpower planning, the combination of productive requirements, or time to be spent in a work status, plus allowances for absence, would provide an estimate of total staff requirements.

periods. Moreover, the month normally varied in length, and administratively both the workmonth and the workday may vary in length from location to location and from time to time.

At the other end of the scale, the use of minutes or seconds for measurement would have served no special purpose and would have implied a degree of precision in time units which would have been inconsistent with the rather broad, group-operation work units decided upon.

The MAN-HOUR, however, was a unit by which the employees could record their time on a continuous daily basis, with *reasonable precision* and a *minimum of paper work*. In addition, the man-hour could be charged to the operations in which the time was actually expended, and could be readily verified against official agency pay-roll records.

The analysts realized also that the man-hour unit would be consistent with any more refined measurement that might be needed later for purposes of improving specific jobs, tasks, or operations, inasmuch as hour decimals are commonly used even in detailed time and motion study.

For such reasons, they chose the man-hour as the time unit for work measurement in the AGO.

A Look Around

Having gone so far, they thought they'd better have a look around and see how they stood. They wanted to be very sure they were right this time. Before investing the time that would be needed to develop and install a workable reporting system, which at best would continue to take a certain amount of time after installation, they wanted to be certain that they would not be called "out" at home plate for not touching all bases along the way.

As summarized in figure 12, they had—

1. Analyzed the activities and identified *operations* as the *level* for measurement.
2. Identified valid *units of work* to be counted in the measurable operations.
3. Identified the *man-hour* as the appropriate *unit of time*.

The chart shown here summarizes those steps as carried out in the Organization Records Branch.

SUMMARY ANALYSIS

ACTIVITIES & OPERATIONS	WORK UNITS	TIME UNITS
BRANCH CHIEF'S OFFICE	None	Man Hour
ADMINISTRATIVE		
Mail and Messenger	None	Man Hour
Supply	None	Man Hour
Labor Force	None	Man Hour
ACCESSIONING & PROCESSING		
Receipt and Checking	A File Drawer Accessioned	Man Hour
Palletizing	A Linear Foot Palletized	Man Hour
First Echelon Processing	A Linear Foot Screened	Man Hour
Record Perfection	A Linear Foot Perfected	Man Hour
SPECIAL SERVICE		
Routine Searches	A Case Processed	Man Hour
Special Searches	A Case Processed	Man Hour
CORRESPONDENCE	A Letter Prepared	Man Hour

Figure 12

You will see that the branch chief's office is shown at the head of the list of activities. For reasons very similar to those given for the administrative-service activity, the work of the branch chief's office was considered unmeasurable. The staff was small; its work highly variable, and not directly related in kind and amount to the ordinary work load of the branch. Regardless of variation in work load, the branch would still have a chief, who would have to have at least a minimum staff.

Although no work unit was assigned to the chief's office, all working time was to be reported, just as in the administrative-service activities, so that there would be 100-percent time reporting for all employees in the branch. Thereby all manpower requirements for the branch could be accounted for—most in terms of production rates and the remainder in terms of man-hours alone.

CHAPTER VI. DEVELOPING A REPORTING SYSTEM

- ✓ RECORDS FOR COLLECTING WORKLOAD AND TIME
- ✓ INSTRUCTIONS FOR RECORDING AND REPORTING
- ✓ REPORTS FOR TRANSMITTING DATA
- ✓ CONSOLIDATION AND SUMMARY
- ✓ ROUTING SYSTEM

The AGO people now knew what work they should and could measure, as well as why they wanted to do it. They were confident about the terms of measurement that they had chosen—the *operation* work units and the *man-hour* time units. But all of that would do no good until they could develop a mechanism for gathering the actual time and work-load facts and putting them to work.

Gathering the facts meant *recording*. Putting them to work, *reporting*. Simplicity had to be a keynote.

Even so, they saw that they needed—

1. Records and recording instructions for collecting work-load and time information.
2. Report forms and instructions for transmitting the recorded data.
3. A procedure for consolidating and routing the key facts up the line, and for routing agency-wide summaries back down.

It had to be a give-and-take proposition. But the basic forms and instructions had to be centrally designed, and standardized throughout the agency; and the instructions had to be uniformly interpreted and applied. Uniformity in those essentials was a "must," in order that (*a*) the raw data collected would be valid and comparable, (*b*) the computations made and the conclusions drawn would be equitable, and (*c*) the results would be available in a readily usable form on a timely basis.

Records and Recording Instructions

Because simplicity was the keynote, the management staff working closely with the line people in all divisions and branches, made every effort to—

1. Use existing records when possible, even though such records were originally designed for other purposes.
2. Eliminate unnecessary records.
3. Maintain records at a single control point for an operation wherever possible, instead of having each employee maintain an individual record.
4. Keep the recording process simple by using the fewest number of records to produce the required data.

The basic record-keeping form that they developed (figs. 13 and 14) had two parts: (1) The daily work-load time record for accumulating the necessary quantitative information, and (2) written instructions for the preparation and maintenance of the record.

The form provided for the daily entry of (1) the starting volume of work on hand, work received, completed, and day-ending balance (fig. 13), and (2) the number of employees assigned, the amount of employee time expended, leave time taken, and man-hours detailed in and out of the operation (fig. 14). Although in practice the daily work-load and time record was a single form, the two main parts are shown separately here.

The written instructions accompanying each form covered specifically: (1) The definition of the operation to be measured, (2) the definition and description of the unit of measure to be applied, and (3) the method of counting and recording the work load. Attention was given to the need for all the employees to understand those instructions.

In the Organization Records Branch, it was evident that one basic work-load time record could be

BASIC DAILY WORK LOAD TIME RECORD

OUTPUT AND PERSONNEL REPORT

OPERATION	WORK UNIT	ON HAND	IN	OUT	BALANCE	EM AS
Receipt & Checking	File Drawer Ac.					
Palletizing	L Ft Palletized					
1st Echelon Processing	L Ft Screened					
Perfecting	L Ft Perfected					
Routine Searches	Case Processed					
Special Searches	Case Processed					
Correspondence	Letter Prepared	1774	160	110	1824	
Mail & Messenger						
Supply						
Labor Force						
Branch Chief's Office						
REMARKS						

Figure 13

maintained at the *central control desk* for each operation. That plan was possible because a number of employees were regularly assigned to each operation. The shifting of personnel from one operation to another could thus be readily controlled, and adjustments necessitated by the detailing of employees among operations could be easily recorded. Work-load and time entries for the correspondence activity are shown here to illustrate the use of the form.

In some parts of the AGO, however, it was clear that records would need to be maintained by the individual employees—an adjustment to operating situations in which (1) employees divided their time among a number of operations during the course of the day, and (2) no central work-control point was feasible.

The *frequency* of recording would depend upon the nature of the operation. As a general rule, daily recording was expected to be adequate. But in some cases the recording of time, work load, or both would have to be done at more frequent intervals. If operations were short and employees were shifted frequently from one operation to another, the frequency of recording generally would need to be increased to obtain accurate and reliable results.

Reports and Reporting Instructions

With the mechanics set up for *recording* work load and time data, some means of consolidating and *reporting* the information had to be established. This required the development of an adequate report form and instructions for reporting.

The report form that was designed (fig. 15) could be readily filled out from the prescribed records. Care was taken to make the instructions for preparing the report both clear and complete.

The content of the form was governed by the needs of management at levels having responsibility for a broader area of work than that of the immediate supervisor who maintained the basic records. In some instances, the detail required at the oper-

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ating level was not needed by the higher levels. *Only such data were included as would serve a useful purpose as the report moved upward through the organization.*

The design of the summary report form included—

1. A report number or symbol;
2. Space for the name of the bureau, branch, and section using the form;
3. A short descriptive title of the report;
4. Column headings and stubs which were clearly titled and numbered for cross reference with the instructions;
5. Space for entering the time period covered and name of the activity or operations measured; and
6. Space for work-load and time data for each activity or operation.

Consolidation and Routing Procedure

The development of a plan for consolidating and routing the resulting facts was the final step in the creation of an integrated record-keeping and reporting system.

In the submission and use of the reports, time was of the essence, for the work-measurement data were intended to serve as a basis for management decision and action. It was, therefore, necessary that the routing plan should—

1. Establish deadlines for reporting;
2. Prescribe the channels for transmitting the reports from the operating level upward through the organization, and
3. Systematize the movement of summary data back to the operating levels.

As already shown, the supervisors in the Organization Records Branch were to maintain daily

BASIC DAILY WORK LOAD TIME RECORD

	DATE					
CE	NO. EMPL. ASGD	MAN-HOUR BREAKDOWN				
		EX-PENDED	LEAVE	TRAIN-ING	DET'D IN	DET'D OUT	TOTAL
	22	168	8		8		176
	x 8						

Figure 14

WEEKLY SUMMARY REPORT

OUTPUT AND PERSONNEL REPORT					REPORTS CONTROL SYMBOL AGCP-2 FOR WEEK ENDING FRIDAY January 24					
BUREAU OR SERVICE Records Adm. Center		BRANCH Org. Records			SECTION					
1	2	3	4	5	6	7	8			
OPERATION	WORK UNIT	WORK UNITS ON HAND AT BEGINNING OF WEEK	INTAKE OF WORK UNITS	OUTPUT OF WORK UNITS	WORK UNITS ON HAND AT END OF WEEK	NUMBER OF FULL-TIME EMPLOYEES ON ROLLS	MAN-HOURS EXP.		OUR. WEEK DETAILED	
							REGULAR TIME	OVERTIME	IN	OUT
Receipt & Checking Palletizing 1st Echelon Process. Perfecting Routine Searches Special Searches Correspondence Mail & Messenger Supply Labor Force Branch Chief's Off.	Letter prepared	1,774	806	552	2,028	22	480	20	20	
9. NUMBER OF CASES OF DELAYED CORRESPONDENCE REPORTED DURING WEEK WITHIN THE BRANCH										

Figure 15

records of work load and man-hours. Those daily records were to be consolidated and summarized each week and routed to the branch chief. The branch office was to review the reports, compare current with past performance, have the time records verified against official time and attendance records, and spot check the validity of the work-load statistics. (See fig. 16.)

Within 3 days after the end of the reporting week, a consolidated summary report for the branch was to reach the commanding officer of the Records Administration Center. There the reports from the various branches were to be consolidated for local analysis and for submission to the Management Division of the Office of The Adjutant General. Consolidated reports would be due in that office by the fifth day after the end of the reporting period.

The Management Division made plans for thoroughly analyzing the summary reports of all activities of the Office of The Adjutant General and summarizing them by means of text, tables, and charts. First a master tabular summary would be made for each operation. Next, a graphic presentation would be devised to trace the performance of an operation on a time-trend basis.

A brief narrative report would be prepared every 2 weeks to highlight and interpret important developments in performance and work load for The Adjutant General. That biweekly report, generally supplemented by tables and charts, would reach The Adjutant General within 5 days after the arrival of the second week's summary data in the Management Division.

Copies of both the brief narrative and supporting charts would be distributed to division and branch chiefs so that they and their employees could be informed about the highlights of production. The report would contain references to areas of outstanding performance as well as to areas operating below satisfactory limits.

ROUTING OF REPORTS

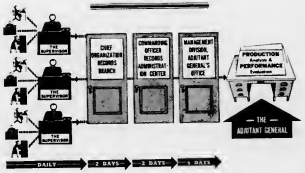

Figure 16

As the work-measurement data would be consolidated at each level, the reports would provide the management at that level with a current picture of the work of the office of The Adjutant General as a whole and enable the people at the operating levels to see their own role in the broader picture.

One reason for the difference in reporting frequency (weekly reporting by the operator and biweekly review by The Adjutant General) was to establish clearly the principle that responsibility for knowing the facts and taking localized action rested with the operating chiefs.

Pilot Installation

About 6 weeks of hard work had been required to do the general orientation, select the level for measurement, select the right work and time units, and develop a reporting system.

Despite that amount of care and attention, however, the management staff felt that the final agency-wide installation should be preceded by a 4-week test run in the Organization Records Branch.

This trial period gave staff an opportunity to eliminate "bugs" in the mechanics of the system—recording, reporting, and tabulating. Also, even though operating personnel and officials of the center had worked closely with the work-measurement analysts in the development of the system, they were given the opportunity to review the reporting system and discuss plans for its final installation and use.

In retrospect, that step, with the precedent it set for continuing review of the system as operating conditions changed, appears to have been a major influence on the success of the system.

CHAPTER VII. ESTABLISHING STANDARDS

[1] PRODUCTION RATE ATTAINABLE

[2] OPERATING DIFFERENCES CONSIDERED

[3] FREQUENT CHANGE NOT EXPECTED

[4] EQUITABLE AS BASIS OF COMPARISON

From the beginning the work-measurement reports began to serve their purpose in day-to-day supervision, programming and scheduling, budgeting, and management improvement (as explained in the next chapter).

But to increase and sharpen the usefulness of the data, the management staff, still working closely with the line people, now focused on another phase in the development of the work-measurement system. That phase—the establishment of standards—was aimed at:

1. Facilitating the analysis of the work-measurement data for management control, budgeting, and management improvement,
2. Assisting in comparative studies of performance, and
3. Providing goals or incentives.

The AGO felt that the development of sound standards would have to be a long-range objective, and that caution was necessary. A bad standard can be far worse than none. Therefore, the analysts wanted to get complete agreement *on criteria for judging any rate proposed as a standard;* they wanted to resolve any confusion that existed concerning *methods of setting standards;* and they wanted to make no mistake in choosing the best method for *developing standards from statistical work-measurement records* such as they had now installed.

The Criteria for Judging Standards

Here are the conditions which, after considerable thought and discussion, the analysts and operating people agreed any work-output standard should meet—

1. *Attainability.* Any rate set as a basis for comparison (whether an adjusted norm or an ultimate standard) should be attainable. Any normal group of workers, under adequate working conditions, should be able to equal the rate with reasonable effort.
2. *Applicability.* The standard should be applicable to the peculiar operating differences which may exist among seemingly identical installations. While undesired variables in the work itself should be eliminated, it is not always possible to achieve a high degree of uniformity. This may result in the setting of several standards for similar installations, depending on the degree of comparability which exists among any group of them. As long as significant differences in operating practice or working conditions are justifiable, differences in production rate are often justifiable also. Even as tentative production goals give way to true standards it is necessary to recognize those justifiable operating differences. Therefore, more than one standard may be established for an operation if the differences are of enough significance.
3. *Permanence.* By their very nature standards cannot be subject to casual change. Once established, production standards should change only as operating conditions themselves change. A real standard, therefore, must reflect management's considered judgment, as well as the attainment of some degree of work standardization. Even a tentative rate or norm used in lieu of a standard (pending improvements in job methods) should be

set carefully enough that it can be defended and applied long enough for a fair trial.

4. *Equitability.* Any rate set—and most especially the production standard—should be an equitable basis for comparison. The differences in deviation from the standard rate, by different groups doing the same work or by the same group at different times, should reflect true differences in effort, ability, or the quality of supervision.

So that those conditions could be met, steps had to be taken in some instances to—

1. Level out the peaks and valleys of production resulting from seasonal factors and other internal and external influences, where such factors were controllable.
2. Assure proper balance between work load and work force at the work stations.
3. Establish desirable work-scheduling practices.
4. Make needed changes in organization and work methods, and verify the effect of such improvements on rates of output, before standard rates are set.

Those steps, however, represented improvements that had to be brought about over a continuing period of time. The attempt to set standards emphasized the need for such improvements, and the making of improvements brought the need for further revisions in the standards. It was a continuous cycle.

The Methods of Setting Standards

The AGO management people were not especially surprised to find rather widespread confusion about rate-setting methods; but they wanted to be sure that misunderstanding would not hamper the development of standards. They wanted all concerned to understand, for example, that time study is not necessarily stop-watch study, just as method study is not necessarily motion study.

Reviewing all the rate-setting practices they had heard of, and all the different names that different people applied to those practices, they concluded that the principal rate-setting methods could be lumped under three headings:

1. Precisely engineered, or stop-watch, standard;
2. Subjective standards, and
3. Statistical work-measurement standards.

Precisely Engineered Standards

In developing engineered standards an individual job or operation is analyzed; its elemental motions identified, needless ones eliminated, others recombined as appropriate; tools, equipment, work-place lay-out, and work flow are standardized. After standardization, the job is time-studied in detail as performed by a worker considered to be of at least average ability.

By accumulating the time readings for all elements of the job, allowing for fatigue and other delay factors, and applying a "leveling" factor to compensate for abnormal skill or effort on the part of the worker, a rate is derived which becomes the standard for all workers performing the same operation under standard conditions.

That, in general, is the method used for many routine, repetitive, large-volume operations. As a regular device for measuring output and setting standards, its usefulness (in relation to the cost of using it) diminishes as the work to be measured becomes less routine and as the number of workers doing identical work decreases.

A variation of that approach is known as setting synthetic standards. Synthetic standards often are useful where jobs, although not alike in whole, are made up of different combinations of standard elements (or standard tasks).

For example, time-study data accumulated over a long period for various standardized operations on certain standard machines, processing specified materials, can be used in connection with standard tables of machine speeds to "build up" a rate even in advance of setting up a job.

Only a relatively small part of the work of Government, however, lends itself to rigid standardization or to time and motion study as a basis for setting standard rates of output.

Used selectively, nevertheless, time and motion study can be valuable in two ways:

1. In setting standards for the few large-scale repetitive operations that can be highly standardized over a wide area, and
2. In analyzing and simplifying otherwise complex or troublesome procedures.

It must be noted also that time and motion study is not a technique of work measurement apart from and in competition with statistical work measurement; rather it complements the statistical method.

Subjective Standards

Subjective judgment enters, to some extent, in the setting of work standards by any method. In contrast to the precisely engineered standard based on time and motion study, however, there are various rule-of-thumb standards based only upon the experience and opinion of individual supervisors.

Sometimes such "standards" are better than none at all. Even when the supervisor makes an accurate guess, however, he has no basis on which to explain and justify it, and the general disagreement that results may more than offset any value that the standard might have had.

Quite often production records exist which are not based on the kind of work and time units that are needed for work-measurement purposes. Such records, nevertheless, may offer quantitative information good enough to improve the subjective estimates that are being used as standards.

In lieu of existing records, simple work counts also are sometimes used as a means of taking some of the guesswork out of the subjective approach.

The standards established by those methods can be set quickly; but that very fact is one of the main arguments against their use, for there may be considerable disagreement concerning the standards' applicability, equitability, and accuracy.

Statistical Work Measurement Standards

Going beyond the subjective approach, but not to the detailed precision of engineered standards, is the statistical method dealt with in this case study.

The *statistical work measurement standard* combines sound *statistical experience* and *analysis* with the *considered judgment* of management, to arrive at reliable standards that are attainable, applicable, relatively permanent, and equitable.

The statistical method is more flexible than the stop-watch method. It can be applied at different levels of work and in the presence of varying (but certainly not unlimited) degrees of work standardization.

As already suggested, however, the stop-watch method (time and motion study) and the statistical approach often are ideally used in combination. For example, the stop-watch can be useful in simplifying some of the tasks in an operation, even though the operation as a whole cannot be standardized. In other instances, some operations may be standardized and rated by the stop-watch method, even though other operations in the same activity (hence the efficiency of the activity as a whole) can only be measured statistically.

At any rate, the AGO people were satisfied that the simple, statistical reporting system that they had installed would be a satisfactory basis for production standards, provided the criteria that had been agreed upon were carefully followed.

Developing Standards from Work Measurement Records

Before the AGO could set production standards, it would have to accumulate information on existing rates of output, analyze that information, decide what variations in production method should be ironed out, and then gather and analyze more rate data as production methods were altered.

Production Rates

As the work-measurement reports came in, the analysts related the work completed and the time consumed, in order to arrive at so-called "work measurement ratios," or production rates, which served a dual purpose—(1) immediate use as a tool for management and (2) a base for establishing production standards at some future date.

The production rates could be expressed in either of two ways:

1. Number of work units produced per man-hour (as four cases per man-hour), or
2. Number of man-hours expended per work unit (as 0.25 man-hours per case).

The chief consideration in deciding which way to express any given rate was its understandability to those who would use it. For example, a production rate of 0.10 cases processed per man-hour might be more easily understood if expressed inversely as 10 man-hours per case.

During the first few months, the staff concerned itself principally with an examination of the causes of variations in rates for like operations performed at different locations and the causes of fluctuations occurring over a number of biweekly periods for the same operation at the same location. Examination revealed that the variations and fluctuations resulted mainly from these causes—

1. *Errors in reporting.* Errors that were the result of ambiguous definitions or instructions had to be corrected as quickly as possible to prevent the reporting of meaningless data.

2. *Varying work methods.* Different supervisors had devised different working procedures. The differences affected production rates. Management wanted to encourage innovation and experimentation; but when varying work methods made significant differences among operations that were subject to the same standard, either the better method had to be adopted uniformly or the standard rate set aside.
3. *Different working conditions.* Where differences in office lay-out, plant facilities, caliber of personnel, employee morale, or in agency clientele were found to have a pronounced effect upon production, corrective action was necessary before a common standard could be applied.
4. *Different quality standards.* Some supervisors were found to be requiring higher quality than others, for a similar operation. One supervisor, for example insisted upon 100-percent inspection of outgoing form letters, while another achieved a higher rate of output by requiring only sampling inspection. It was up to management to decide where the balance between high production and high quality should fall. Uniform standards of quality are basic to uniform standards of output.

Considering the variations and fluctuations in the early production rates reported, what significance could be attached to them? Were such rates a suitable basis for establishing standards?

The production rate for one operation was plotted on a biweekly basis for several reporting periods (fig. 17). During the first four periods, the production

EARLY RESULTS – WHAT DO THEY MEAN ?

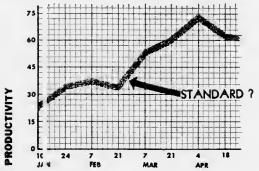

Figure 17

rate leveled off. A production standard might have been set at the end of the four periods. That such a decision would have been unsound is evident from the fact that in the following weeks the production rate soared upward, illustrating very graphically the need for great care before setting a permanent measure. It is reemphasized here, because any premature attempt to fix hard and fast standards can wreck an otherwise good work-measurement system.

Production Norms

As actual production rates were accumulated and steps were taken to reduce the controllable variations in procedures and working conditions, the actual rates were supplemented by "production norms." The production norms—adjusted as appropriate on the basis of actual production experience and a knowledge of operating conditions—could serve as tentative bench marks, or interim yardsticks, pending the establishment of production standards. That use of the norms provided a trial-and-error stimulus to the improvement and standardization of work methods and the development of standard production rates.

For example, a tentative "standard," based on the production norm, was set for one operation after the production rates had appeared to level off for a number of months, as shown in fig. 18. The rate of 1.7 work units per man-hour appeared to be a sound measure as long as work intake and backlog remained fairly level. The operation appeared to be under control. Consequently, no special management attention was given to it. A sudden increase in intake, however, resulted in a large increase in backlog. The production rate responded immediately to the increased work load, and the rate of 1.7 units per man-hour became obviously inapplicable.

In the light of the new conditions, the process of setting a "standard" had to be repeated, with production experience leading to a production norm and finally to an actual production standard.

Production Standards

After going through the period of accumulating production-rate data, making necessary improvements in operating conditions, and experimenting with norms and tentative standards, the AGO people were ready to screen the findings and establish final standards where appropriate.

Based on work-measurement data, then, what

EXPERIMENTING WITH TENTATIVE STANDARDS

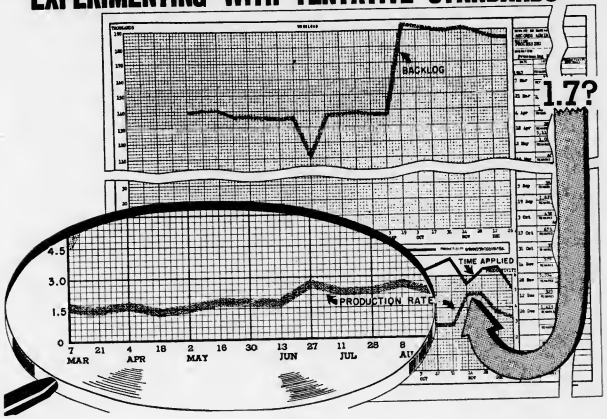

Figure 18

rate of production should be selected as the standard? To what extent should the standard be a "target rate"? Those are among the questions that had to be decided. Management had to establish an understandable policy on how the standards were to be set and what they were to mean.

To illustrate the possibilities, an array of production rates for one operation is shown in figure 19. Some of the people recommended that the median be taken as the standard; but the median appeared too low, since (by definition) half of the rates were already above it, and one rate was several times greater. Others favored the *average;* but it didn't provide the necessary incentive factor either. Several rates were almost double.

More common than the median or the average, for the purpose, is the *upper-quartile.* That rate would provide an incentive factor; and yet it seemed attainable, for 25 percent of the production rates were already above it.

Other factors, however, had to be taken into account. In this instance, the concentration of high production rates at the top of the array represented recent production under improved work methods. Judgment was necessary, therefore, to determine the

HOW STANDARDS ARE ESTABLISHED

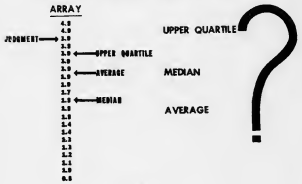

Figure 19

rate at which production could be expected to continue as a result of the new methods.

Experience in the following year proved the correctness of that appraisal. It proved also that a formula for the setting of a standard is best used only as a guide. Each standard must be established on its own merits and in terms of the characteristics of the operation for which the standard is being set.

The standard must be set high enough to provide a goal to be reached; yet there must be assurance that the goal *can* be reached. It must be based on reliable and adequate experience data. It must be realistic in terms of special operating problems and seasonal work-load fluctuations; and implicit in the standard must be a set of minimum quality requirements.

Production standards, it was recognized, were means to improved management, and not ends in themselves. They serve as guides against which to appraise performance. By watching deviations from those guides, problem areas are identified, and attention is focused on the areas in need of further study.

Once the problem areas are identified, management improvement techniques can be applied to obtain increased productivity and better utilization of resources. In addition, standards may serve as incentives, indicating the level of output expected from the investment of a specified amount of manpower.

CHAPTER VIII. USING WORK-MEASUREMENT DATA

- MANAGEMENT IMPROVEMENT
- PROGRAMMING AND SCHEDULING
- BUDGETING

Once The Adjutant General's work-measurement system was properly installed, its success depended upon the use made of it at the various levels of management. *Use, however, had been the major consideration throughout its development.* As the level for measurement, the work unit, and the time unit had been selected, and the reporting plan developed, the needs of the supervisors, branch chiefs, division heads, and The Adjutant General had been continuously appraised and the system adapted accordingly.

All in all, work measurement formed a sound administrative reporting system by which key people at various levels of management could obtain accurate, current, brief, and pertinent data from which to make more reliable decisions in administering the business of the AGO. Let's look at some of the ways in which the system made that kind of contribution through *management improvement, programming and scheduling,* and *budgeting.*

Management Improvement

Work measurement in the AGO became one means of regularly reviewing and appraising operating and management practices.

By providing accurate and reliable data concerning performance and work load, the AGO work-measurement system highlighted the areas in need of study by the organization and methods office and the personnel office. In addition, continued observation of the work-measurement data showed the effect of actions taken. The data pointed up before-and-after effects of procedural, organizational, lay-out and other related changes, and the effect of personnel actions such as training, counselling, recruitment, or placement.

Improvements by the Supervisor

In one instance a supervisor had set a tentative standard for his operation after observing the production rates of the various workers (fig. 20). He went on, however, to find out why the output of some workers was appreciably lower than that of the others. Calling for help from the management technicians as needed, he improved the methods and conditions of work. Then, in view of continued performance above the level of the old standard, the supervisor raised the standard to a higher level consistent with the increased production rates.

The standard set by the supervisor for his operation might have been above the production norm or standard acceptable to top management for all operations of a given class, but the higher standard in this instance was his own working tool. He applied it within his own shop as a continuing incentive for his particular group.

Let's look a little more closely at another example (fig. 21). The backlog of the "Veterans' Admin-

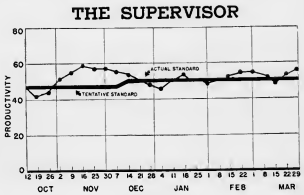

Figure 20

istration operation" in the Officer Personnel Information Section had risen to 20,491 cases as of January 1947, and the trend was toward an even greater backlog. The organization was faced with the immediate problem of reducing that backlog and offsetting the trend. What action should be taken?

The work-measurement system provided management with a comprehensive picture of the backlog, intake, output, and number of employees engaged in the operation. Similar information was available for related operations. By analysis of such data, management took three specific steps:

1. Temporarily increased the number of employees on the Veterans' Administration operation, taking people from operations with decreasing work loads;
2. Assigned analysts to examine the problem and devise methods for handling the increased work volume;
3. Assigned employees with the proper skills to perform the new procedure, and developed training aids for employees assigned.

With that attack on the problem, the backlog of Veterans' Administration cases was reduced to 1,722 by July 1947. Analysis of work-measurement data, thus, had helped management to:

1. Recognize the problem;
2. Determine the course of action to be taken;
3. Appraise the effect of the action; and
4. Maintain control over the problem until the operation was on a current basis.

As the work load decreased, the extra employees were gradually withdrawn and assigned to other operations.

Figure 22 represents a further example of the role of work measurement in solving management problems.

The emphasis here is on the timely personnel action taken as a result of indicators provided by work-measurement.

New procedures had been introduced to reduce backlogs; but, instead, employee productivity decreased because, as the analysts discovered, the new procedures were not well understood. The supervisor immediately called for help in providing special

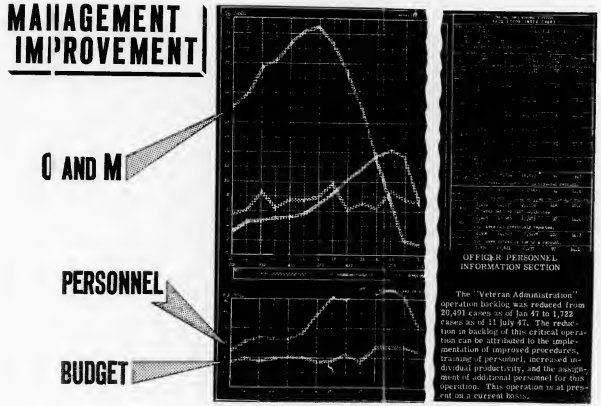

Figure 21

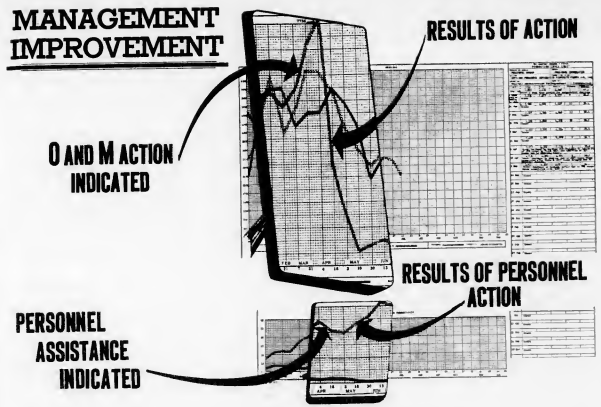

Figure 22

training, the success of which is demonstrated by the increase in productivity.

The Branch Chief

Not only the supervisor, but his branch chief as well could apply work-measurement data in detecting the need for improved operations. In fact, as the reports came to the branch chief from the various operations (under different supervisors) he could draw comparisons which the individual supervisors were not in position to make.

The branch chief's evaluation often took two forms:

1. A time-trend analysis of an operation; and
2. Comparison of production rates (performance) for the same operation performed by several comparable organizational units within the branch over the same time period.

Branch-office use of the data in comparing similar operations of different sections or groups is illustrated by figure 23. Seven organizational units were performing comparable operations—"records," "verification and pay," "change of officer records," "statements of service," and "whereabouts."

Despite comparability in procedures and uniformity of definition, there were sharp differences in the production rates of the different groups. For example, in the "change of officer records," unit A took almost twice as long as unit B to produce a single finished unit of work. There may, however, be very justifiable reasons for difference in per-

Figure 23

INTENTIONAL SECOND EXPOSURE

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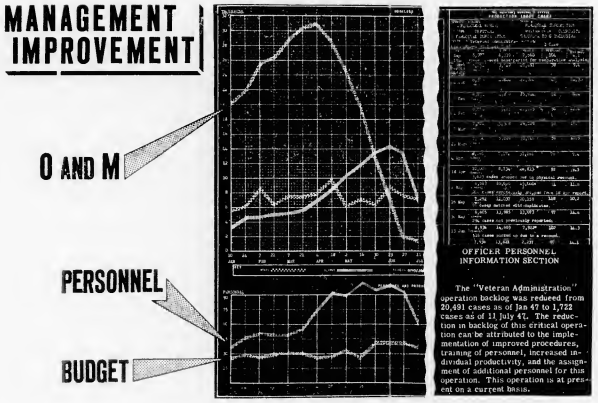

Figure 21

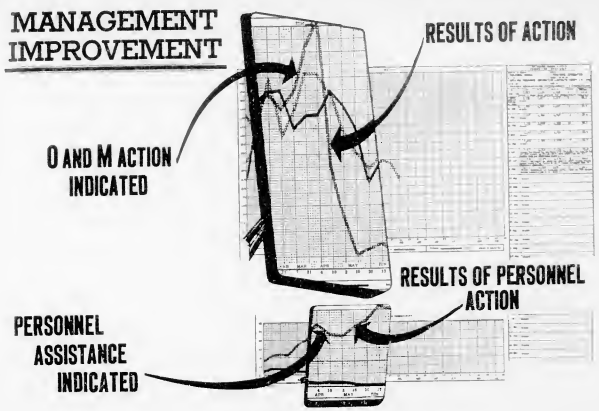

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Figure 23

formance, and management must be able to identify those reasons. Thus, care must be taken in analyzing and appraising the comparative data before conclusions are finally drawn. Work-measurement data should serve primarily as an indicator, pointing the way to further investigation, if needed, for decision and action.

In this illustration, the branch chief knew that a reorganization and change in work methods had recently taken place. He was interested, therefore, in knowing whether productivity was going to be better under the new procedure than under the old. He wanted to know also what follow-up action was needed. Based on these data he continued his contacts with the organization and methods examiners and with the personnel officer in order that adequate training, assignment of staff, and work analysis could be completed.

The Division Heads and Top Management

From the branch chiefs, selected work-measurement data are funneled up to the division heads and The Adjutant General. To the extent that work-measurement results have been analyzed at subordinate levels, top management is better assured that conditions are under control. It is thus left free to act upon problems beyond the scope of lower organization levels, and in turn can rely on subordinate levels to bring serious situations to its attention.

Programming and Scheduling

Work programming and program scheduling are related both to management improvement and to the budget process.

Before the budget can be formulated, consideration is given to various proposed projects and activities. They are reviewed to evaluate need and importance in terms of program objectives, costs, and required resources. The effect of such variable factors as speed, economy, and quality of service are weighed in determining manpower and dollar costs.

The projects are screened, and the approved projects are arranged in priority sequence, according to a set time schedule. The comprehensive list becomes the agency work program. Measured work load, time, and production-rate data provide the information needed to appraise the manpower and cost requirements of the projects in relation to speed, economy, and quality.

The execution of the work program (and, as will be seen, the budget based upon it) involves replanning and rescheduling, which may be made necessary because—

1. Congressional action may result in the appropriation of amounts different from those requested; disapproval or curtailment of some of the programs; and initiation of programs not originally presented.
2. An unbalanced condition of resources may occur, such as more personnel than facilities; or obstacles may be encountered in the availability of resources (procurement) or in the use of resources (operations).
3. Changes in cost, upward or downward, may alter the quantity or quality of work that can be financed.
4. New legislation may require a complete reexamination of the whole plan, for existing programs of the agency may be changed or new programs added. Additional work load often results, necessitating a request for supplemental funds.
5. Improvements in procedures, equipment, or facilities may step up the rate of progress and necessitate revision of schedules.

Figure 24 shows how The Adjutant General's budget office applied work-measurement reports to programming and scheduling.

The reports indicated that work load in the Reserve Branch was decreasing at a more rapid rate than had been estimated—a signal that some replanning or rescheduling was in order. Examination revealed further that operating backlogs were under control. The branch consequently could undertake other work.

The lists of deferred projects were examined and a project which the War Department General Staff had requested in December 1945 was found to be first on the list of special projects. It had been deferred in favor of higher-priority work, but it could now be given consideration.

In order to complete an estimated volume of 500,000 units of work by June 30, 1947, weekly output would have had to be 40,000 units. Work-measurement production rates were analyzed. Previous experience indicated that a production rate of 10 units an hour, including leave and administration time, could be expected. That meant that a staff of 100 full-time employees would be required to maintain the 40,000 weekly volume. The reduction in the work load of the branch indicated that at least that number of employees would be available.

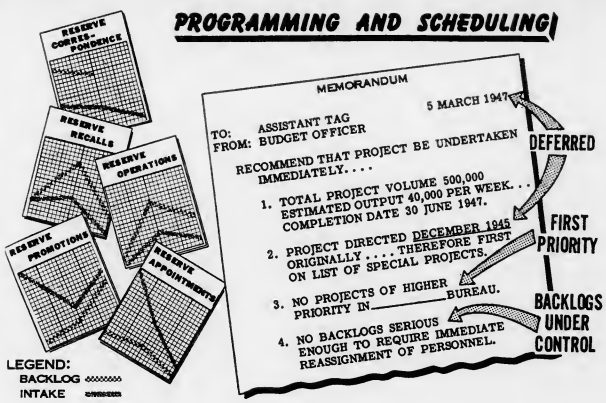

Figure 24

The Adjutant General was able to report to the General Staff that the special project could now be undertaken, with a completion date of June 30, 1947. A close check would be required to assure the maintenance of that schedule. Deviations from the schedule would be disclosed by the work-measurement records of the branch. Based on that information, timely management action could be taken, if necessary, in order to meet the deadline.

The operating supervisor, also, used work measurement from day to day for planning, scheduling, and controlling his work. He learned to analyze the data submitted for the previous day and then to assign personnel to operations according to the quantity of work to be done and the time required to do it. Thus, he could shift personnel more readily in response to changes in emphasis or in the volume of work load in specific areas. Work measurement also helped him to determine whether additional work could be undertaken and, if so, the time that would be required to complete it.

Budgeting

Work measurement provides a means of putting the budget on a performance basis—making it an action document, a device for forecasting and appraising accomplishment. Work measurement makes its contribution both through budget formulation and budget execution.

Formulation

With the AGO budget process decentralized to the supervisory level, the supervisor, operating within certain broad assumptions provided by the central budget office, prepares the initial forecast of personnel and other budgetary requirements for his operation. The supervisor thus provides the base for the budget by obtaining from the work-measurement reports the experience data on work load and production rates required for budget formulation.

The budget requirements are then consolidated into an integrated program as they move up through the organization. The requirements are expressed in terms of anticipated work load and

production rates which are the result of experience trends.

The budget that is finally approved for a particular program by The Adjutant General, as illustrated by figure 25, represents a value judgment backed by concrete experience and work forecasts.

The shifting state of the work in the Organization Records Branch was reflected in the budget. For example, the projected work volume for the "receiving and checking" and "palletizing" operations was being reduced while, on the other hand, the work volume of two of the newer operations—"first echelon processing" and "record perfection"—was increasing. The actual and anticipated production rates per clerk were affected by the changes in work volume.

Despite the decreases in work volume in "receiving and checking" and "palletizing" operations, management anticipated no change in output per clerk since procedures and work habits had been well defined and established.

In the two operations that were increasing in volume—"first echelon processing" and "record perfection"—it was presumed that the increase should result in better procedures and skill in handling the work. Consequently, management anticipated that the production rates per employee should increase approximately fourfold for those particular operations.

In another operation—"routine searches"—the production-rate estimate was reduced to 0.75 cases per day per employee because management felt a higher quality of service should be given to the public and the military organizations requesting information from the branch.

By relating work volume and the production rate, the man-day requirements for each of the operations was determined.

There are, however, a number of operations which are measured in terms of time expenditure only, and for which no work-load data are gathered. Those "unmeasurable" areas were determined, it will be remembered, at the time the system was installed. They included the branch chief's office, maintenance labor, mail and messenger, and supply services. The demand for those services is related to the work volume of the operating area, but they do not necessarily increase or decrease in direct proportion to increases or decreases in the volume of operations.

The requirements for still other overhead and service operations were based on past requirements plus adjustments to meet increasing or decreasing needs. Thus, although operating requirements had been increased by 26 percent, the overhead and service requirements were raised only 5 percent.

The sum total of operating man-days plus overhead man-days represents the total work-time requirements of the branch. But since leave time is a consideration, a leave factor of 15 percent is allowed, based on the past experience of the branch.

BUDGET FORMULATION

	1947			1948		
	WORK VOLUME COMPLETED	ACTUAL PROD. RATE PER CLERK	PROD. MAN DAYS	PROJ. WORK VOLUME	PROD. RATE ANTICIPATED PER CLERK	MAN DAYS REQ.
RECEIVING AND CHECKING	66,550	10.5	6,338	22,360	10.5	2,130
PALLETIZING	61,602	8.6	7,163	24,250	8.6	2,820
FIRST ECHELON PROCESSING	3,646*	1.3	2,804	62,520	6.0	10,420
RECORD PERFECTION	1,971*	.65	3,032	11,124	2.4	4,635
ROUTINE SEARCHES	39,911	1.6	24,944	38,750	.75	51,665
SPECIAL SEARCHES	13,183	3.0	4,398	12,450	3.0	4,150
CORRESPONDENCE	37,862	4.8	7,888	36,650	5.7	6,430
BRANCH CHIEF'S OFFICE			8,500			8,840
LABOR FORCE			6,360			6,760
MAIL AND MESSENGER			2,440			2,520
SUPPLY			2,280			2,420
SUB TOTAL			76,147			102,790
LEAVE (15%)			11,422			15,419
GRAND TOTAL			87,569			118,209
PERSONNEL EQUIVALENT			346			467

*In Operation Less Than Six Months

Figure 25

Execution

It is in providing a means of analyzing manpower utilization, work progress, performance, and personnel costs that work measurement serves a purpose in budget execution.

Figure 26 illustrates the use of work measurement in budget execution, for two purposes: (1) Allotment of manpower and funds through an analysis of work progress and performance, and (2) the determination of project cost estimates.

It is possible to derive both costs and expenditures largely from the use of work-measurement work units, for in Government, generally, funds spent for personal services alone amount to about 75 percent of all operating expenses.

In the formulation phase of budget administration, forecasts of work load and production rates give expression to program goals. In execution, actual performance is compared with the earlier forecasts by means of time-trend charts, such as the one illustrated. Deviations from the forecasts are the basis for changes in manpower and fund allotments. Those changes permit the re-establishment of a balance among manpower, work load, and costs.

Based on work-measurement data, cost estimates, such as the one illustrated in this chart, can be made accurately. The cost estimate, as in this case, was at times used as a basis for obtaining reimbursement for services rendered to another agency. In

BUDGET EXECUTION . . . .

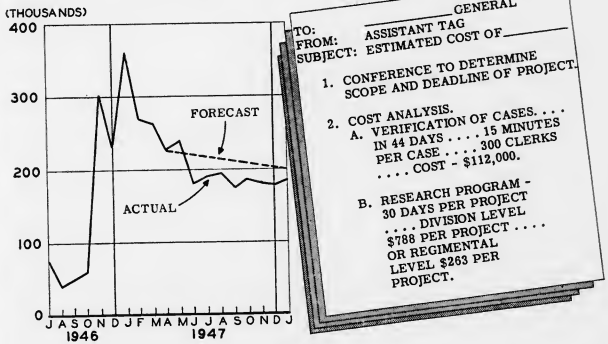

Figure 26

this instance, The Adjutant General had been asked to examine 420,000 service records by another branch of the Army. The job was done on reimbursement. Production records indicated that it took 15 minutes to verify each case. The 15 minutes included leave, supervisory, and indirect time. The request stipulated that the work had to be completed in 2 months (44 working days). It was estimated, therefore, that 300 full-time employees would be needed to complete the work within that time. Since the average daily pay per employee working on this project was $8.50, the total cost of the project was estimated to be $112,000. Similar tabulations were made to determine the cost of the research program on the divisional and regimental level.

We have mentioned here only a few examples of the uses which the AGO made of work-measurement data in bringing about management improvements, tightening up its work programming and scheduling processes, and building a performance budget. The next chapter will give an example of how work measurement was used to construct an agency-wide index of productivity.

CHAPTER IX. SIZING UP THE AGENCY AND THE SYSTEM

After the war, the office of The Adjutant General went through a period of retrenchment. Emphasis shifted to a peacetime program, requiring fewer dollars. As a result employment was cut, personnel were reassigned, and in some cases retrained. Reorganizations were effected throughout by consolidation and by the establishment of new divisions to handle the peacetime program.

The work-measurement system was the means by which the AGO was able to foretell the effect that reorganizations, changes in work-load emphasis, and changes in work methods would have on the ability of the agency to keep current with its work. Decisions on where personnel reductions could best be made, what the need would be for retraining and reassignment, and which categories of personnel should be affected in carrying out reductions in force were all based on the analysis of productivity forecasts using work-measurement data.

Index of Agency Efficiency

After the retrenchment was completed, The Adjutant General wanted to know the impact of the changes on the agency's performance. He asked for a brief, over-all status report—a thumbnail picture of agency-wide efficiency.

Developing such a report made it necessary to summarize the work-measurement information for the whole agency in a way that the management people had not done before. They knew in theory that for this purpose they would have either to find a single representative (or "focal") measure or else to develop a composite or weighted measure for work load and employee time expended, and, accordingly, for the over-all rate of output. The trend of the production rate could tell them whether they were gaining or losing in total operating efficiency. Of even greater significance, however, in demonstrating what the organization had been capable of accomplishing, were the trends of incoming work load and of backlog accumulation or reduction. In addition, although both output and applied time would be reflected by the production-rate trend, it was considered important to show a separate trend of applied manpower (employee time), because the reduction in personnel was a key factor in the retrenchment program.

Thus, four separate trends were developed, as shown in figure 27, each covering an annual period: one trend for backlog (work on hand); one for incoming work; one for total employee time; and one for employee efficiency.

Trend of Work on Hand

The work on hand for the whole AGO was summarized in terms of the number of man-days required to eliminate it. The man-day was a common unit into which all work load—regardless of the work measure—could be translated; and the translation to man-days produced a trend that showed the effect of increasing productivity on the backlog. On the other hand, work load expressed directly in composite or weighted work units would not have indicated the volume of activity or effort represented by the work on hand, and would not have shown the results of increased productivity in bringing backlogs under control.

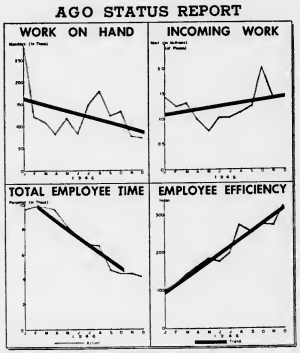

Figure 27

The number of work units on hand for each operation, as shown by the last work-measurement summary for each month (column 6, fig. 15), was converted to equivalent man-hours by relating work units on hand to the prevailing production rates. Once the work units completed in the various operations were converted to man-hours, the job was essentially a simple count of man-hours applied. The man-hour was a unit of measure that was not only reliably representative of all the different work units but also meaningful in relation to personnel strength.

Trend of Incoming Work

Developing a trend for incoming work was simpler, because it was found that (as a rough over-all indicator of work-load trend) incoming mail was adequately representative of all the AGO work. The amount of mail received each month was totaled and plotted, in millions of pieces.

It would have been possible to weight the principal types of correspondence according to degrees of difficulty in processing. The volume, however, was great enough that, for purposes of an over-all trend, ordinary differences could be assumed to average out. Furthermore, the simple count of incoming mail was easy to compute and simple to understand and explain.

It would have been easy, also, to count outgoing mail. The analysts knew, however, that work was occasioned by many incoming messages (new data added to the records, and so on) which did not require replies.

Trend of Applied Time

The average number of personnel on duty throughout each month, as taken from the work-measurement reports (columns 7 and 8, fig. 15) was used as the basis for the figures shown on the total employee time chart. The official strength reports would not have been adequate; they accounted only for the number of employees on the pay roll. It was known that from time to time during the year considerable numbers of persons had been borrowed from organizations outside the AGO to help eliminate emergency backlogs. The pay roll would have been closer to the correct figure than the strength report because it would have reflected paid overtime hours and persons on reimbursable detail. However, only the work-measurement reports contained, in addition, the hours worked on voluntary overtime and on voluntary detail.

Trend of Efficiency

It was more difficult to find a single indicator of over-all operating efficiency than it had been to find appropriate trend indicators for the other three factors. The single indicator of efficiency would somehow have to equate the production rates for all the different operations of the agency in such a way that an index could be developed to represent the increase or decrease in the total productivity of the agency. It was an indication of *productive capacity per employee* that The Adjutant General wanted. As compared with productivity during a representative base period *before* the retrenchment occurred, how much greater or lower was the productivity now? What productivity did the trend show to be likely in the near future?

That picture was developed by weighting the average production rates (in units of output per man-hour) for each of the principal operations and adding the resulting aggregates (representing about 65 percent of total agency work) for a representative period before retrenchment; and then, using that average as a base of 100 percent, plotting the average of the aggregates similarly computed for the same operations in each of the 12 following months, as related to the base.

Another expression of efficiency (the reciprocal of the above), which is often used where production standards exist, is known as the "effectiveness rate." The standard rate is given in "standard hours," a standard hour representing the number of work units that should be produced per man-hour in a given operation. The effectiveness rate is determined by relating the man-hours actually used to the standard hours called for in the production of a specified number of work units. The effectiveness rate is then expressed as a percentage. (If the standard hour calls for 100 units and actual production is 110, the effectiveness rate is 110 percent.) Weighted aggregates taken from the effectiveness rates for the various operations, can be totaled and averaged to give an over-all effectiveness rate. It should be observed, however, that such a rate is customarily based on production standards. As pointed out in chapter VII, production standards, by their very nature, imply a more or less stable production situation in which further increases in productivity cannot be expected without further improvements in methods or facilities. In this instance change had been the order of the day.

The changes in method that had occurred during retrenchment would have made it necessary to revise the standards that had existed. The problem, then, was not to relate actual performance to standard performance but to develop a trend of actual productivity as an indicator of future requirements in the way of staff resources and management-improvement action.

Whatever the method of expressing relative efficiency, quality must be a consideration. Neither an individual production rate nor an over-all trend of productivity expresses quality explicitly; but, to be valid, both must imply that the quality of output remains constant. The Adjutant General knew that quality had been a factor in selecting the rates that had been used during the retrenchment. He knew also that, in the reassignment and training of personnel, emphasis had been placed as much upon the quality of work as upon the quantity. Therefore, in interpreting the changes in productive capacity shown by the trend charts, he might well infer that quality had not varied significantly.

Cautions and Limitations

Such index charts can be extremely useful to top management and may be maintained continuously. Their usefulness at operating levels, however, is more limited, because combined measures may not lend themselves readily to operating decisions.

In the AGO, the four charts discussed in this chapter have been useful in budget presentation, and in explaining—in a general way—to higher levels in the Department, the significant trends in operations. It is much easier for The Adjutant General or his principal staff and operating assistants to explain conditions to persons outside the organization, and for those outsiders to understand, if the information can be given in summary form rather than in details. That is especially true, as in the case of budget presentation, when outsiders are not concerned with or are not too familiar with the day-to-day operation of the agency, or when, from personal observation, they already have confidence in the detailed data from which the summaries are prepared.

Within the AGO, division heads may occasionally develop over-all trend indicators of their own, when a single trend will more readily clarify a situation. They prefer ordinarily, however, to rely on more detailed data and to give The Adjutant General sufficient information concerning the factors which underly the situation being presented. In fact, the work-measurement system, in the form discussed in this bulletin, was originally established in preference to a system based on indices and composite or weighted measures; and there has been no tendency to have over-all indicators replace the more detailed system.

Over-all indicators are *not* a substitute for operating data. Indices are reliable and valid only to the extent that approximately the same relationship continues to exist among all the quantities used in the original computation. Thus, if work load weights change radically, if operating methods change so that production data do not mean the same as they did, the over-all indicator no longer measures what it was intended to measure.

Even if entirely accurate and equitable at all times, the over-all indices are of little value in making operating improvements or estimating personnel requirements. The regular work-measurement reports, on the other hand, contain the same information directly attributable to operations; and, as already shown, can be put to work not only for general appraisal but in many other ways for better management. The AGO, therefore, resisted pressures to extend the use of the agency-wide indices and cautioned against undue dependence on such devices at division and branch levels.

In any event, the AGO Status Report was useful in showing over-all operating progress. Not only did it demonstrate rising efficiency and a shrinking backlog, despite a growing work load and falling employment; but the trends were pronounced and sustained enough to suggest that further improvement should be expected.

An Inference of the System's Worth

It would be hard to say exactly how much the work-measurement system contributed to the results achieved. It seemed fair to assume, however, that work measurement had been instrumental in obtaining better performance through more effective use of resources. It had provided the supervisor, branch chiefs, division heads, and The Adjutant General with a tool for—

1. Effectively controlling operations.
2. Locating areas of outstanding and substandard performance.

3. Comparing performance of like operations.
4. Appraising the effect of changes in organization, procedures, personnel recruitment policies, training, physical lay-out, equipment, etc.
5. Forecasting and justifying future staff requirements in relation to projected volumes of work.
6. Balancing personnel and work load.
7. Programming and scheduling work.
8. Building a performance budget.

In other words, work measurement had provided The Adjutant General with the means of establishing a budget based on program goals and work measured in terms of program accomplishments, as well as with the indicators which enabled management to take the required action to obtain efficiency of operation.

Work measurement had become a key to better management.

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U. S. Forest Service. JOB LOAD ANALYSIS AND PLANNING OF EXECUTIVE WORK IN NATIONAL FOREST ADMINISTRATION; A MANUAL FOR FOREST OFFICERS. (By E. W. Loveridge, Washington, U. S. Govt. Print. Off., 1932. 236 p.)

A discussion of methods and examples of the forms used in the measurement and recording of work in the National Forest Administration.

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PROCESS CHARTING, November 1945—A practical working device in attacking management problems.

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